The significance of the examination of the white cells in the blood of 100 cases of Pulmonary Tuberculosis.

by

Harry Evans. MB. ChB. Edin 1912.

M. D. 1920.

In making this investigation I obtained permission from the Physicians of the Brompton Hospital to use the clinical material which the institution afforded: all the subjects were in-patients of the hospital: they all were suffering from pulmonary tuberculosis and in each case tubercle bacilli had been found in the sputum after admission to the institution.

The blood was taken at 11 a.m. or 9 p.m. (ie. about 3 hours after the last meal). In each case a leucoyte count was made (dilution 1 in 10): films on cover glasses were obtained which were stained by Jenner's method: a differential count was made and also the actual number of lymphoytes and polymorphs pr. cm. estimated.

The results are recorded in the columns of the following tables:-

Column 1 The number of the case.
Column 11 the initials of the patient.
" 111 the sex of the patient.
" 1V the age of the patient.
" V the duration of the disease in years.
" V1 the stage of the local disease in the lungs.
1 = Deposit.
11 = Consolidation.
111= Cavitation.
" V11 the lencocyte count
cols 8 - x1 the Differential count.
cols 12 - 13 the actual count.

In the criticism of the actual number of the different types of leucocytes present : whether an increase or a diminution is present? the normal percentage of polymorphs is taken as from 60% to 75%. and the normal percentage of lymphocytes as from 25% to 40%.

This gives, taking the normal leucocyte count as 7000, an actual number of:-

Polymorphs 4200 - to 5250) pr cm
Lymphocytes 1750-to 2800)

the above limits are considered physiological as recommended in "The Blood" Gulland and Goodall. pages 70 and 78.

Under the heading lymphocytes I have included

Small Lymphocytes.
Large Lymphocytes.
Large Mononuclear Leucocytes.
and Transitional Leucocytes.

The cases are arranged in 3 groups:-

Group 1 Cases with no systemic intoxication whatever: these patients were afebrile; pulse not quickened: able to be up all day and to do work in the hospital.

Group 11 Cases with marked systemic intoxication i.e. an evening temperature of 99 - 100 with rapidity of pulse etc.

Group 111 Cases with grave systemic intoxication these were mostly moribund.

GROUP 1 49 cases numbered 1 to 49 with no systemic intoxication whatever.

Number of Case	Name of patient	Sex	Age	Duration of disease	Stage of disease	Leucocyte Count.	Percentage Number per Cm.				Actual number per Cm.		
							Polymorpho	Eosinophils	Lymphocytes	Basophils	Polymorpho	Eosinophils	Lymphocytes
1	AS	M	53	1 6/12	III	9200	74	4	21	1	6808	368	1932
2	JS	M	42	2	II	7100	52	1	47		3692	71	3337
3	WB	M	44	2	II	4200	55	4	40	1	2310	168	1680
4	RD	F	21	2	II	7200	52	4	44		3744	288	3168
5	HB	F	47	3/12	II	8100	42	2	55	1	3402	162	4455
6	RB	F	37	1 6/12	II	3200	58	6	36		1856	192	1152
7	MW	F	26	10/12	II	6000	55	3	42		3300	180	2520
8	GG	M	29	1	II	8200	62	1	37		5084	82	3034
9	VW	F	23	2	II	10.000	52	1	47		5200	100	4700
10	MA	F	14	2	III	4400	73	1	25	1	3212	44	1100
11	VH	F	18	9/12	II	3500	53	1	46		1855	35	1610
12	MB	F	15	9/12	II	9000	66	2	31	1	5940	180	2790
13	VW	F	16	2	II	4400	57	5	38		2508	220	1672
14	GK	F	21	2	II	6500	57	3	40		3705	195	2600
15	AW	M	27	1	II	5000	70	5	25		3500	250	1250
16	EL	M	50	6	III	3100	56	1	43		1736	31	1333
17	FJ	M	25	2	II	4700	55		45		2585		2115
18	HC	M	17	1 6/12	I	4300	59	2	39		2537	86	1677
19	SC	M	18	1	II	6100	59	5	35	1	3599	305	2135
20	MA	F	45	1	II	6300	62	5	33		3906	315	2079
21	AL	F	49	6	III	6000	71	1	28		4260	60	1680
22	HG	M	17	6/12	III	5700	69	1	30		2933	57	1710
23	JES	M	24	3/12	II	8800	43	3	53	1	2494	174	3074
24	WP	M	31	3	I	6200	54	4	41	1	3348	248	2542

GROUP 1 Contd.

Number of Case	Name of patient	Sex	Age	Duration of disease	Stage of disease	Leucocyte Count	Percentage number per Cm.				Actual number per Cm.		
							Polymorphs	Eosinophils	Lymphocytes	Basophils	Polymorphs	Eosinophils	Lymphocytes
25	AM	M	18	4/12	II	9800	52	5	43		5096	490	4214
26	DR	F	20	1 6/12	III	3400	58	2	40		1972	68	1360
27	SS	M	18	1	III	9100	67	2	31		6079	182	2821
28	JB	M	39	3	III	9000	64	6	30		5760	540	2700
29	WH	M	25	1 6/12	II	4000	54	2	44		2160	80	1760
30	EB	M	11	2	II	4800	68	4	28		3264	192	1344
31	MG	M	37	1/12	II	4100	56	4	40		2296	164	1640
32	FC	M	44	1	III	7300	71	1	28		5183	73	2044
33	FJ	M	38	1 6/12	III	2000	72	3	24	1	1440	60	480
34	FO	M	22	1	II	4900	51	2	46	1	2499	98	2254
35	ED	F	36	1	II	2900	65	4	31		1885	116	899
36	EK	F	35	1	II	3000	62	1	37		1860	30	1110
37	FP	F	28	1	II	6700	73	1	26		4891	67	1742
38	JR	M	48	2	II	5200	64	2	34		3328	104	1768
39	AS	F	26	8/12	II	3800	71	1	27	1	2698	38	1026
40	DD	M	13	1	III	5900	67	1	32		3953	59	1888
41	AC	M	33	3	III	5700	66	2	32		3762	114	1824
42	AD	M	36	4	II	4600	68	2	30		3128	92	1380
43	JM	M	23	1 6/12	III	10200	51	3	46		5202	306	4692
44	EG	M	30	6/12	II	5900	74	1	24	1	4366	59	1416
45	SH	M	34	4	II	4700	52	2	46		2444	94	2162
46	HR	M	28	1	II	3300	63	1	36		2079	33	1188
47	CH	M	20	9/12	III	5700	66		34		3762		1938
48	WS	M	29	3/12	III	6700	61	3	36		4087	201	2412
49	HB	M	20	2	II	5700	63	3	33	1	3591	171	1881

Deductions from figures in Group 1.

① The average leucocyte count in the 49 cases was 3542 pr cm: only 6 cases were above 9,000 and one of these had had a recent haemoptysis.

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② The Differential Count shows a relatively small percentage of polymorphs and a relatively high percentage of lymphocytes.

The average percentage of Polymorphs in the 49 cases is 60%.

The average percentage of Lymphocytes in the 49 cases is 39%.

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③ The actual number of Lymphocytes & Polymorphs pr cm.

On examination it was found that the essential change is a diminution in the absolute number of polymorphs, while the lymphocytes remain at, or slightly above the normal.

31 of the 49 cases showed a diminution in the total number of polymorphs per cm. (i e. leucopenia).

8 of the 49 cases showed an increase in the total number of lymphocytes pr cm while the number of polymorphs was about normal (i e. Relative lymphocytosis).

3 of the 49, cases showed an increase in the total number of polymorphs present: the number of lymphocytes being about normal (i e. a neutrophil leucocytosis:) one of these Case No.1 had had a recent haemoptysis.

7 of the 49 cases showed normal total counts.

GROUP 11 32 cases numbered 50 to 81 marked systemic intoxication.

Number of Case	Name of patient	Sex	Age	Duration of disease	Stage of disease	Leucocytic Count	Percentage number per Cm.				Actual number per Cm		
							Polymorpho	Eosinophils	Lymphocytes	Basophils	Polymorpho	Eosinophils	Lymphocytes
50	AB	F	31	1 6/12	III	3300	72	1	27		2376	33	891
51	FR	M	21	1	II	6750	70	2	28		4725	135	1890
52	HM	M	44	2	II	4200	70	5	25		2940	210	1050
53	J.C.	F	19	2	III	15300	61	2	27		9333	306	5661
54	WW	M	17	1	III	11.000	64	1	35		7040	110	3850
55	GK	M	25	5/12	III	7100	74	2	23	1	5254	142	1633
56	ML	F	37	1	II	7700	68	5	27		5236	385	2079
57	DG	F	28	1 6/12	II	3100	82	1	17		2542	31	527
58	MW	F	26	10	II	7000	76	2	21	1	5320	140	1470
59	EB	F	28	4	III	3000	66	3	31		1980	90	930
60	DC	F	25	1	III	8000	72	1	27		5760	80	2160
61	AR	F	36	3	III	7700	71	4	25		5467	308	1925
62	AR	F	20	1	II	6000	63	1	36		3780	60	2160
63	J.W.	F	26	1	II	7700	72	3	25		5544	231	1925
64	JS	M	22	2	II	9700	69	1	30		6693	97	2910
65	AT	F	27	9/12	II	3900	79	2	19		3081	78	741
66	AL	F	23	2	II	9700	73	2	24	1	7081	194	2328
67	FW.	M	27	2	III	7300	71	1	28		5183	73	2044
68	RS	M	23	6/12	II	11.000	66	1	33		7260	110	3630
69	CH	M	56	3	III	3000	76	6	24		2100	180	720
70	GW	M	10	1	III	4600	57	1	42		2622	46	1932
71	JG	F	19	1	III	4500	87	4	8	1	3915	180	360
72	JR	M	28	1	III	5700	80	1	19		4560	57	1083
73	HM	F	28	2	III	3600	66	2	32		2376	72	1152

GROUP 11 Contd.

Number of case	Name of patient	Sex	Age	Duration of disease	Stage of disease	Leucocyte Count	Percentage number per Cm				Actual number per Cm		
							Polymorphs	Eosinophils	Lymphocytes	Basophils	Polymorphs	Eosinophils	Lymphocytes
74	GL	F	45	2	III	35 00	89	1	11		3080	35	385
75	RM	F	24	9/12	III	7400	91	1	7	1	6734	74	518
76	SS	M	29	16/12	II	8000	71	5	24		5680	400	1920
77	FMcC	M	30	2	III	8000	72	4	24		5760	320	1920
78	HC	M	16	4	III	5300	86	1	13		4558	53	689
79	WM	M	21	2	III	6900	80	1	18	1	5520	69	1242
80	Gr.	M	31	4	II	5000	75	2	23		3750	100	1150
81	WB	M	17	3	II	6200	68	3	28	1	4216	186	1736

Deductions from figures in Group 11.

(1) The average count in the 32 cases was 6910 pr cm.

In 5 of the 32 cases it was above 8000.

(2) The Differential Count showed a relatively small percentage of lymphocytes with a normal percentage of polymorphs.

The average percentage of polymorphs in the 32 cases is 73%

The average " " lymphocytes in the 32 cases is 23%

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(3) The actual number of Polymorphs and lymphocytes pr cm.

Here there seems to be a tendency to a diminution in the absolute, number of lymphocytes present; Only in 5 of the 32 cases was there an actual increase in the total number of lymphocytes and this was associated with a proportionate increase in the polymorphs;

Details are:-

9 of the 32 cases examined showed a diminution in lymphocytes and polymorphs.

2 of the 32 cases examined showed a diminution in lymphocytes and an increase in polymorphs.

3 of the 32 cases examined showed a diminution in lymphocytes.

5 of the 32 cases " " an increase in lymphocytes and polymorphs.

3 of the 32 cases examined showed a leucopenia.

2 of the 32 " " showed a neutrophil leucocytosis

8 " " " " showed normal counts.

GROUP III 19 Cases, numbered 82-100, with grave systemic intoxication.

Number of Case	Name of patient	Sex	Age	Duration of disease	Stage of disease	Leucocyte Count	Percentage number per Cmm				Actual number per Cmm		
							Polymorpho	Eosinophils	Lymphocytes	Basophils	Polymorpho	Eosinophils	Lymphocytes
82	AP	M	28	5	III	2000	90	2	8		1800	40	160
83	WK	M	27	2	II	5500	78	3	19		4290	165	1045
84	ML	M	33	5/12	III	2400	79		21		1896		504
85	JS	M	29	2 6/12	III	4500	67	2	31		3015	90	1395
86	AA	F	36	2 6/12	III	7000	79	1	20		5530	70	1400
87	AS	M	41	13	III	7700	65		34	1	5005		2618
88	HT	M	42	1	III	18100	77	6	17		13937	1086	3077
89	MH	F	29	9/12	III	5100	80	1	19		4080	51	969
90	JK	M	28	2	III	5400	77	1	22		4158	54	1188
91	WC	F	17	6/12	II	6700	77	1	22		5159	67	1474
92	JA	F	16	1/12	III	10.700	81	2	16	1	8667	214	1712
93	LB	F	24	16/12	III	5900	87	1	12		5133	59	708
94	AJ	M	29	9/12	III	3900	78	4	18		3042	156	702
95	JA	M	23	9/12	III	6900	85	1	14		5865	69	966
96	JB	M	37	16/12	III	2500	75	2	22	1	1875	50	550
97	JC	M	37	9/12	III	4100	85	4	11		3485	164	451
98	PS	M	29	2	III	8500	89	2	9		7565	170	765
99	WT	M	32	11	III	7200	82		18		5904		1296
100	WP	M	28	2	III	5200	84	1	15		4368	52	780

Deductions from figures in Group 111.

(1) The average leucocyte count in the 19 cases was 6279 pr cm.

Cases numbered 82,84 and 94, whose counts were 2000, 2400, and 3900 respectively, died within 48 hours of the blood examination.

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(2) The Differential Counts :-

These show a relatively high percentage of polymorphs and a relatively low percentage of lymphocytes.

The average percentage of polymorpbs in the 19 cases is 80%.

The average percentage of lymphocytes in the 19 cases is 17%.

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(3) The actual number of lymphocytes and Polymorphs pr cm.

Here the outstanding feature is the diminution in the absolute number of lymphocytes present pr cm.

Only in 1 of the 19 cases was the lymphocyte count slightly increased (Case No 88) this was also associated with a marked neutrophil leucocytosis.

The details are:-

9 of the 19 cases examined showed a diminution in lymphocytes.

Deductions from Figures in Group 111 Con^td.

4 of the 19 cases examined showed a diminution in lymphocytes and polymorphs..

3 of the 19 cases examined showed a diminution in lymphocytes and an increase in polymorphs.

1 of the 19 cases examined showed a leucopenia.

2 of the 19 cases examined showed a neutrophil leucocytosis.

Summary.

(1) The total leucocyte count in cases of tuberculosis without systemic intoxication is low. The average count in 49 cases was 3542 pr cm .

(2) The total leucocyte count in the cases that showed systemic intoxication was slightly higher. The average count in the 51 such cases was 6675 pr cm .

(3) As the systemic intoxication becomes more marked in pulmonary tuberculosis the percentage number of polymorphonuclear lencocytes in the blood seems to increase and the percentage number of lymphocytes to diminish:-

Group 1 Polymorphs 60% Lymphocytes 39%

Group 11 Polymorphs 73% Lymphocytes 23%

Group 111 Polymorphs 80% Lymphocytes 17%

In group 1, ie. the afebrile cases, the increase in lymphocytes is only apparent; as the study of the total number of each type of cell present pr cm. shows that while the total number of lymphocytes is little altered there is a definite diminution in the polymorphs (lencopenia). 64% of the cases in group 1 showed a lencopenia.

(4) As the systemic intoxication becomes more marked there is a tendency to a diminution in the total number of lymphocytes pr cm.:

In group 11 47% of the cases examined showed this diminution and in group 111 (cases with grave systemic intoxication) 87% of the cases showed this diminution in a marked degree.

(5) A careful note of complications such as pleurisy

with effusion, Tb. Epididymitis. Abdominal tuberculosis and laryngeal tuberculosis was made, but no change in the blood picture was observed.

(6) The Eosinophiles varied between normal limits: (7) there appears to be no relationship between the extent of the local disease in the lung and the number of leucocytes present: A large number of the cases examined had Cavity formation, often extensive, associated with a low leucocyte count. cp.

(1) Cabots "Clinical examination of the blood" page 291 para 111" the absence of leucocytosis in any case proves the absence of any cavity of considerable size".

(2) Emerson's "Clinical Diagnosis" page 629 para 2. "In any case of cavity formation there is almost almost always a leucocytosis".

(8) The leucopenia in the early cases of tuberculosis (ie without Septicemic intoxication) and the neutrophil leucocytosis in the hectic cases is in accordance with findings of Gulland & Goodall "The Blood" page 287 para 3. sub paras (a) and (c).

(9) The diminution in the lymphocyte count in the generalised cases of tuberculosis coincides with statement by Osler and McCrae "System of Medicine" Vol 1V. Page 605 para. 2.

(10) There appears to be no relationship between the duration of the disease and the blood picture.

Cases of 2, 4, and 6 years duration, in group 1, all showed the leucopeina and normal lymphocyte count already referred to: whereas cases of 1, 6 and 9

Summary Contd.

months duration, in group III, showed the neutrophil leucocytosis and low lymphocyte count which was shown also by cases of 2, 5 and 11 years duration in the same group.

(ii) The age of the patient does not seem to have any influence on the blood picture which seems to depend entirely on the amount of systemic intoxication present.
